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(54) TITLE OF THE INVENTION
BRUSHLESS MOTOR

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[Amendments: There are no amendments attached to this patent. Translator's note]

[Note: All names, addresses, company names, and brand names are translated in the most common manner. Japanese language does not have singular or plural words unless otherwise specified with numeral prefix or general form of plurality suffix. Page numbers applied to the original patent begins with 227 instead of page 1. Translator's note]

SPECIFICATION

1. TITLE OF THE INVENTION
Brushless motor

2. CLAIMS
1. According to a brushless motor that is equipped with a rotor comprising a rotary axis and plural numbers of permanent magnets that form a magnetic field system, a ring-form yoke part that is arranged at outer side of said rotor, and fixed iron core comprising plural numbers of convex poles that are opposite to said permanent magnets via gap and is arranged at inner side of said yoke part, and armature coils that are coiled around said convex poles, the brushless motor is characterized by the fact that said permanent magnets are fixed to said rotary axis in a circumferential direction with equal distance, and the surfaces of outer circumference of said permanent magnets are magnetized to be of the same pole.

2. The brushless motor that is described in the claim 1, wherein a side plane part of said yoke part in an axial direction is made opposite to the flange part of said rotary axis via gap.

3. The brushless motor that is described in the claim item 2, wherein armature coils are coiled at the side plane part of said yoke part to arrange second convex poles that ae of the same numbers as those of said first convex poles , and they are made opposite to flange part of said rotary axis via gap.

3. DETAILED EXPLANATION OF THS INVENTION
[FIELDS OF INDUSTRIAL APPLICATION]
This invention relates to the brushless motor that is used for a high speed drive such as a spindle and the like of a laser printer device.

[PRIOR ART]
As illustrated in the Figure 4, brushless motor has been conventionally structured with a permanent magnet (1) that forms a magnetic field system that is arranged in a ring-form around a rotary axis (2), and plural numbers of magnetic poles (N pole, S pole) are magnetized as illustrated with a chain line in an alternately adjoining manner toward circumferential direction to form a rotor (3). Fixed iron core (4) equipped with plural numbers of convex poles (42) is arranged inside of a ring-form yoke part (41) to be opposite to outer side of the rotor (3) via gap, and armature coils (5) are coiled around convex poles (42) to generate a revolving magnetic field.

[SUBJECTS SOLVED BY THIS INVENTION]

However, according to above-explained structure, although an alternating magnetic field is applied to the convex poles with rotation of the rotor, because opposing poles (N pole, S pole) are adjacent to each other in the circumferential direction, changes in polarity occur on the magnetic field. Based on the magnetic hysteresis characteristic of the iron core material of fixed iron core, for instance, in the case when a state in which N pole is opposite to one convex pole happens to shift to a state of S pole being opposite, changes occur in magnetic flux density of fixed iron core as illustrated in the Figure 6 (a) in accordance with changes that occur in electrical angle of the rotor based on the changes that occur in the polarity of magnetic field as illustrated in the Figure 6 (b) , and consequently draws a hysteresis loop of a,b,c,d,e,f,g,h, i, a , and this has been known to show a defect of initiating hysteresis loss of the area surrounded with a,b,e,f,i, and a.

This invention's purpose is to offer a brushless motor with high efficiency that does not initiate said hysteresis loss.

[MEANS USED TO SOLVETHE SUBJECTS]

According to a brushless motor that is equipped with a rotary axis, and a rotor comprising plural numbers of permanent magnets that form a magnetic field system, a ring-form yoke part that is arranged at outer side of said rotor, and fixed iron core comprising plural numbers of convex poles that are opposite to said permanent magnets via gap and is arranged at inner side of said yoke part, and armature coils that are coiled around said convex poles, this invention is designed to fix said permanent magnets to said rotary axis with equal distance in circumferential direction to magnetize the outer circumferential surface of said permanent magnets to be of the same pole.

In addition, the side plane part of said yoke part in axial direction is made as opposite to the flange part of said rotary axis via slight gap.

Furthermore, armature coils are coiled around side plane part of said yoke part to arrange second convex poles that are of the same numbers as those of said first convex poles, and they are made opposite to said rotary axis with a gap.

[ACTIONS]

Although changes of increase/decrease of magnetic flux of the fixed iron core may occur by setting the polarity of the outer circumferential surfaces of plural numbers of magnetic poles that form a magnetic field system as identical, because occurrence of changes in polarity (for instance, changes from N pole to S pole) is eliminated, the changes in magnetic flux density of fixed iron core would not draw a hysteresis loop, and hysteresis loss does not occur on the fixed iron core.

[EXAMPLES]

This invention is explained based on the examples illustrated in the Figures.

Figure 1 illustrates a frontal view that shows this invention's example; and Figure 2 illustrates its side cross-sectional view in which permanent magnets (1) that form a magnetic field system are arranged in a ring-form in a circumferential direction with equal distance and are fixed to the rotary axis (2), and outer circumferential surfaces of the permanent magnets (1) are magnetized to be of the same polarity to constitute the rotor (3). Yoke part (41) that is of a ring form is arranged at outer side of the rotor (3), and fixed iron core (4) equipped with plural numbers of convex poles (42) is arranged inside of the yoke part (41), and this is made to be opposite to the permanent magnets (1) via gap; and armature coils (5) are coiled around convex poles (42) to initiate a revolving magnetic field. The side plane part (43) of the yoke part (41) in axial direction is made to be opposite to the flange part (21) of the rotary axis (2) with a slight gap; and magnetic flux discharged from the permanent magnets (1) forms a magnetic circuit by passing through convex poles (42), yoke part (41), side plane part (43), flange part (21), and rotary axis (2), and returning to permanent magnets (1).

Furthermore, the relationship of number of magnetic poles N of the permanent magnets that are the magnetic field system poles and number of convex poles (P) that form a revolving magnetic field is set to be of such already known relationship of for instance, $P = 2N + 1$ to generate a continuous torque; and magnetic pole width (l) of the permanent magnets is set to be ½ of the magnetic pole pitch (L) of circumferential direction.

And therefore, as illustrated in the Figure 2, magnetic flux of the rotor is formed as shown with a chain line; and as all permanent magnets show the magnetic polarity of either N pole or S pole on outer circumferential surfaces, although changes may occur in increase/decrease of magnetic flux density as A,B,C,D of fixed iron core (4) in accordance with the changes in electrical angle of the rotor as illustrated in the Figure 5, no changes in polarity over N,S poles should occur, and hysteresis loss does not generate because hysteresis does not occur on the magnetic flux of the fixed iron core (4).

Furthermore, as illustrated in the Figure 3, it is all right to form the same number of convex poles (44) in the same circumferential directional position as those of convex poles (42) at the side plane part (43) of the yoke part (41), and to arrange armature coils (5') that are coiled in the opposite direction to that of armature coils (5) coiled around convex poles (42) to increase the output as well.

[EFFECTS OF THIS INVENTION]

As explained above, according to this invention, as it is designed not to allow generation of hysteresis loss on the fixed iron core by setting the polarity on the outer circumferential surfaces of plural numbers of magnetic poles that form a magnetic field system to be the same, it shows an effect of offering a highly efficient brushless motor.

4. BRIEF DESCRIPTION OF THE FIGURES

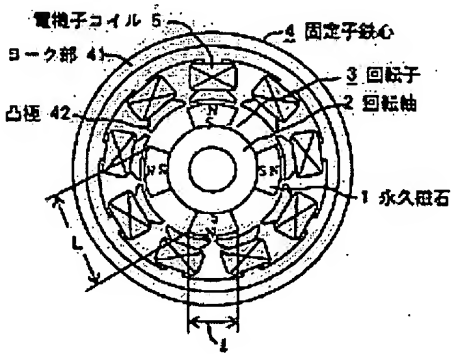
Figure 1 illustrates a frontal view that shows this invention's example; and Figure 2 illustrates its side cross-sectional view; and Figure 3 illustrates a side cross-sectional view of other example; and Figure 4 illustrates a frontal view of conventional example; and Figure 5 (a) shows an explanatory view of state of magnetic flux of fixed iron core of this invention; and Figure 5 (b) shows explanatory view of relationship of changes in electrical angle of the rotor and strength of magnetic field; and Figure 6 (a) shows an explanatory view of state of magnetic flux of fixed iron core of conventional example; and Figure 6 (b) shows an explanatory view of relationship of changes in electrical angle of the rotor and strength of magnetic field of conventional example.

1: permanent magnet, 2: rotary axis, 21: flange part, 3: rotor, 4: fixed iron core, 41: yoke part, 42, 44: convex pole, 43: side plane part, 5, 5': armature coil,

[I: Figure, II: magnetic flux density of fixed iron core, III, IV: strength of magnetic field (AT), V: electrical angle, VI: (degree)]

Figures 1 through 6

第 1 図



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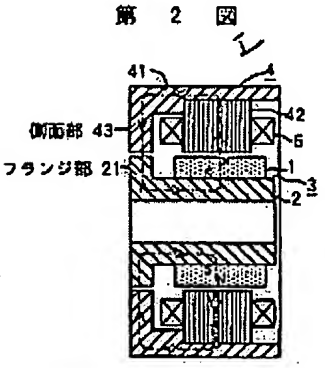

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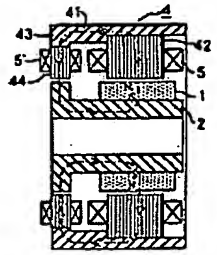

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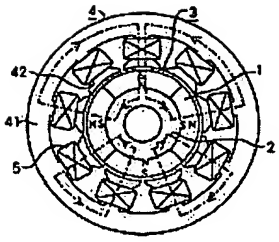

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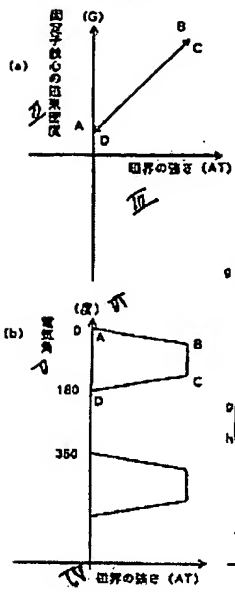

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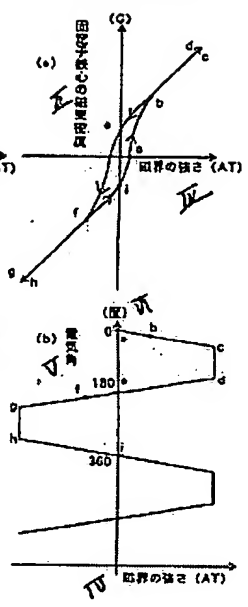

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⑫公開特許公報(A)　平4−101639

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⑬公開　平成4年(1992)4月3日

審査請求　未請求　請求項の数 3　(全3頁)

⑤4発明の名称　ブラシレスモータ

⑳特　願　平2−206211
㉒出　願　平2(1990)8月2日

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明　細　書

1　発明の名称

ブラシレスモータ

2　特許請求の範囲

1．回転軸と前記回転軸の外周に固定し、界磁を形成する複数の永久磁石とからなる回転子と、前記回転子の外側に設けたリング状のヨーク部と前記ヨーク部の内側に前記永久磁石に空隙を介して対向する複数の凸極とからなる固定子鉄心と、前記凸極に巻回した電機子コイルとを備えたブラシレスモータにおいて、

前記永久磁石を前記回転軸に円周方向に等間隔をあけて固定し、かつ前記永久磁石の外周表面が同極になるように着磁したことを特徴とするブラシレスモータ。

2．前記ヨーク部の軸方向の側面部が前記回転軸のフランジ部と空隙を介して対向するようにした請求項1記載のブラシレスモータ。

3．前記ヨーク部の側面部に電機子コイルを巻回し、前記第1の凸極と同数の第2の凸極を設け、前記回転軸のフランジ部と空隙を介して対向させた請求項2記載のブラシレスモータ。

3　発明の詳細な説明

〔産業上の利用分野〕

本発明は、レーザープリンタ装置のスピンドル等の高速駆動に使用されるブラシレスモータに関する。

〔従来の技術〕

従来、ブラシレスモータは例えば第4図に示すように、界磁を形成する永久磁石1を回転軸2にリング状に配置して固定し、永久磁石1の表面に偶数の磁極（N極、S極）が円周方向に交互に隣接するように着磁して一点鎖線で示すような磁束を生じる回転子3を構成している。回転子3の外側には空隙を介して対向し、リング状のヨーク部41の内側に複数の凸極42を備えた固定子鉄心4が設けられ、凸極42には電機子コイル5を巻回して回転磁界を生じさせている。

〔発明が解決しようとする課題〕

ところが、上記構成では回転子の回転にしたが

って、凸極に交番磁界が印加されるが、異極（N極、S極）が円周方向に隣接しているため、磁界に極性の変化が生じる。固定子鉄心の鉄心材料の磁気履歴特性から、例えば一つの凸極にN極が対向している状態からS極が対向する状態に移行する場合、第6図（b）に示す磁界の極性の変化により回転子の電気角の変化に応じて第6図（a）に示す固定子鉄心の磁束密度の変化はa，b，c，d，e，f，g，h，i，aとヒステリシスループを描き、a，b，e，f，i，aで囲まれた面積のヒステリシス損を生じる欠点があった。

本発明は、ヒステリシス損を生じることがない高効率のブラシレスモータを提供することを目的とするものである。

［課題を解決するための手段］

本発明は、回転軸と前記回転軸の外周に固定し、界磁を形成する複数の永久磁石とからなる回転子と、前記回転子の外側に設けたリング状のヨーク部と前記ヨーク部の内側に前記永久磁石に空隙を介して対向する複数の第1の凸極とからなる固定子鉄心と、前記第1の凸極に巻回した電機子コイルとを備えたブラシレスモータにおいて、前記永久磁石を前記回転軸に円周方向に等間隔をあけて固定し、前記永久磁石の外周表面が同極になるように着磁したものである。

また、前記ヨーク部の軸方向の側面部が前記回転軸のフランジ部と僅かな空隙を介して対向するようにしたものである。

また、前記ヨーク部の側面部に電機子コイルを巻回し、前記第1の凸極と同数の第2の凸極を設け、前記回転軸に空隙を介して対向させたものである。

［作用］

界磁を形成する複数の磁極の外周表面の極性を同一にして、固定子鉄心の磁束の増減の変化はあるが、極性の変化（例えばN極からS極への変化）はなくしてあるので、固定子鉄心の磁束密度の変化はヒステリシスループを描かず、固定子鉄心にヒステリシス損が発生しない。

［実施例］

本発明を図に示す実施例について説明する。

第1図は本発明の実施例を示す正面図、第2図はその側断面図で、界磁を形成する永久磁石1を回転軸2に円周方向に等間隔をあけてリング状に配置して固定し、永久磁石1の外周表面が同極になるように着磁して回転子3を構成してある。回転子3の外側にはリング状のヨーク部41と、ヨーク部41の内側に永久磁石1と空隙を介して対向する複数の凸極42とを備えた固定子鉄心4が設けられ、凸極42には電機子コイル5を巻回して回転磁界を生じさせている。ヨーク部41の軸方向の側面部43は回転軸2のフランジ部21と僅かな空隙を介して対向するようにしてあり、永久磁石1から出た磁束が凸極42、ヨーク部41、側面部43、フランジ部21、回転軸2を通り、永久磁石1に戻る磁気回路を形成している。

なお、界磁極である永久磁石の磁極数Nと回転磁界を形成する凸極数Pとの関係は連続してトルクが発生するように、公知の例えば、

$$P = 2N + 1$$

の関係にして、永久磁石の磁極幅ℓは円周方向の磁極ピッチLの1／2にしてある。

したがって、回転子の磁束は第2図に一点鎖線で示すように生成され、どの永久磁石1も外周表面はN極またはS極のいずれか一方の磁極になっているので、第5図に示すように、回転子の電気角の変化に応じて固定子鉄心4の磁束密度はA，B，C，Dと増減の変化はあるが、N，S極にまたがる極性の変化はなく、固定子鉄心4の磁束にはヒステリシスは生じないので、ヒステリシス損は発生しない。

なお、第3図に示すように、ヨーク部41の側面部43に凸極42と同じ円周方向位置に同数の凸極44を形成し、凸極42に巻回された電機子コイル5と反対方向に巻回された電機子コイル5'を設けて出力をアップさせてもよい。

［発明の効果］

以上述べたように、本発明によれば、界磁を形成する複数の磁極の外周表面の極性を同一にして固定子鉄心にヒステリシス損が発生しないように

してあるので、高効率のブラシレスモータを提供できる効果がある。

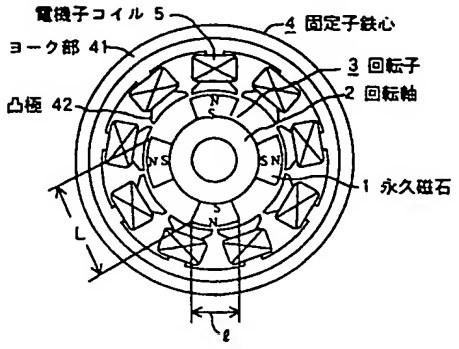
4 図面の簡単な説明

第1図は本発明の実施例を示す正面図、第2図はその側断面図、第3図は他の実施例を示す側断面図、第4図は従来例を示す正面図、第5図（a）は本発明の固定子鉄心の磁束の状態を示す説明図、第5図（b）は回転子の電気角の変化と磁界の強さの関係を示す説明図、第6図（a）は従来例の固定子鉄心の磁束の状態を示す説明図、第6図（b）は従来例の回転子の電気角の変化と磁界の強さの関係を示す説明図である。

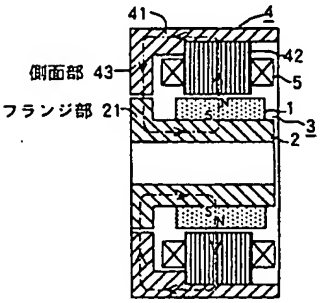
1…永久磁石、2…回転軸、21…フランジ部、3…回転子、4…固定子鉄心、41…ヨーク部、42、44…凸極、43…側面部、5、5'…電機子コイル

特許出願人　株式会社　安川電機製作所
代表者　菊池　功

第1図



第2図



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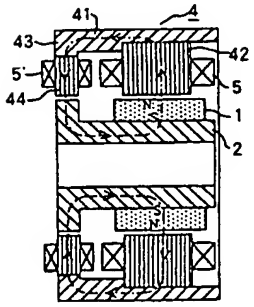

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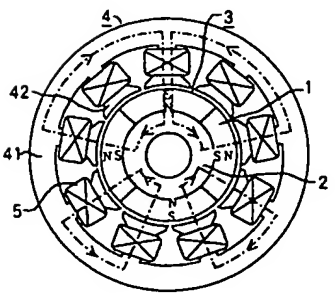

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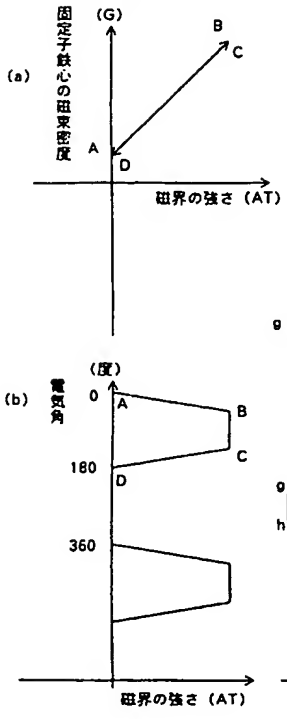
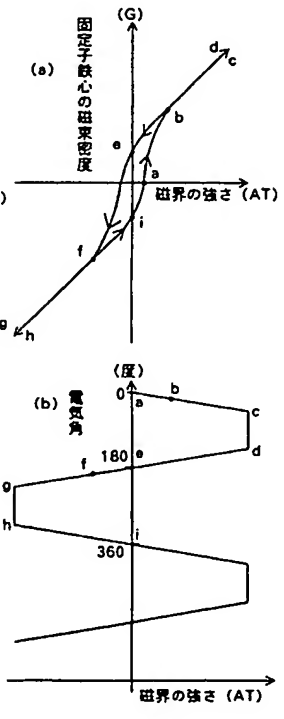


第6図



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We would prefer to receive the translation by e-mail if possible.


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